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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/089,682	06/25/2002	Ulrich Ratzinger	930008-2070	2736

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EXAMINER	
JOHNSTON, PHILLIP A	
ART UNIT	**PAPER NUMBER**
2881	

DATE MAILED: 08/27/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/089,682	RATZINGER ET AL.
	Examiner	Art Unit
	Phillip A Johnston	2881

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-40* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-40* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 June 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *6* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

Detailed Action

Claims Rejection – 35 U.S.C. 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,172,463 to Cutler, in view of Shrader, U.S. Patent No. 5,767,625.

Regarding Claims 1-9, 19-21, and 37-40, Cutler (463) discloses in FIG. 1 a generalized representation of a Drift Tube Linac (DTL) system. The system begins with a charged-particle injector 10, which extracts charged particles (e.g. H+ions) from a charged-particle source and injects the extracted charged particles into a preliminary particle accelerator 12. The charged particles are accelerated by preliminary particle accelerator 12 to a desired speed and then injected into a DTL 14. It should be noted that DTL systems do not require the use of preliminary particle accelerators in all applications, though in certain applications the use of such preliminary particle

accelerators is preferred. DTL 14 includes a RF field chamber 16 and a plurality of substantially cylindrical hollow drift tubes 20 located within chamber 16. Chamber 16 is maintained in a vacuum and has an inlet port 28 and an exit port 30. An RF field generator 26 produces an oscillating RF field within chamber 16 oriented to direct charged particles along a line of acceleration 32 between inlet port 28 of chamber 16 and exit port 30 of chamber 16. Each drift tube 20 is positioned within chamber 16 by a stem 22 extending from drift tube 20 to an inner surface 24 of chamber 16. Bore tubes 50 co-axial with drift tube 20 extends through drift tubes 20 along line of acceleration 32. The direction of acceleration of charged particles along line 32 within chamber 16 is dependent upon the sign of the RF field within the chamber, which changes during the field's oscillations.

Through means known in the prior art, charged particles enter chamber 16 not as a continuous stream of charged particles, but rather as a series of "bursts" of charged particles. The entry of each "burst" of charged particles into chamber 16 is controlled to occur at a time when the RF field is oriented to accelerate charged particles toward exit port 30 of chamber 16. Drift tubes 20 are also positioned to shield each "burst" of charged particles from the RF field during the time when the RF field is oriented to accelerate charged particles toward inlet port 28. In this way, the charged particles are accelerated by the RF field only as the particles pass through gaps 34 between successive drift tubes 20 (or between a drift tube 20 and a port 28 or 30) and only in the direction of exit port 30. The lengths 36 of drift tubes 20 are controlled to ensure shielding of charged particles during the entire period in which the oscillating RF field

would accelerate the charged particles toward inlet port 28. Because the speed of charged particles increases with the traversing of each gap 34 between adjacent drill tubes 20, length 36 increases with each successive drift tube 20 between inlet port 28 and exit port 30.

Upon exiting chamber 16 and DTL 14, the charged particles are directed toward and impact a target 38. In certain applications, additional linear accelerators (or some other form of accelerator) and/or beam transport systems may be utilized between DTL 14 and target 38. Each drift tube 20 houses a cylindrical focusing/defocusing magnet 52 having a cylindrical magnet orifice 53 (see FIG. 4). The central axes of magnet 52 and magnet orifice 53 are substantially co-linear with line of acceleration 32. Magnet 52 serves to maintain the size and alignment of the charged-particle beam as the beam passes through DTL 14. See Column 3, line 52-67; and Column 4, line 1-41.

Cutler (463) as applied above does not disclose the use of an electron beam source to supply high frequency power for ion beam acceleration, as recited in Claims 1, 19, and 37. However, Shrader (625) discloses a vacuum tube particularly adapted for deriving a relatively narrow bandwidth sinusoidal type wave that is applied to a particle accelerator stage. The tube of FIG. 1 includes coaxial input connection 10, which is connected to coupling loop 12, coupled to coaxial non-regenerative coupler 14, in turn connected to grid-cathode assembly 16. Electrons from the cathode of assembly 16 are density modulated by the grid of the assembly and the resulting electron bunches are accelerated by the DC field between the grid and grounded

accelerating anode 18; for the particle accelerator application, the voltage between grid-cathode assembly 16 and anode 18 is on the order of 85 kV. Electrons passing through aperture 19 in anode 18 traverse output resonator 20, thence are incident on collector 22. Resonator 20 includes output loop 24 and a variable tuning capacitor including plate 26 that is movable transversely of the vacuum tube center line 28. A vacuum is provided in the volume subsisting between grid-cathode assembly 16 and collector 22, while most of coupler 14, loop 12 and connector 10 are at atmospheric pressure or slightly above.

Anode 18 and the exterior of metal housing 32 for loop 12, coupler 14 and assembly 16 are maintained at ground potential, while grid-cathode assembly 16 is maintained at approximately -85 kV. The grid of assembly 16 is maintained at a voltage of approximately -280 V relative to the cathode. DC bias for the grid of assembly 16 is applied to single "live" terminal connector 36 mounted on exterior wall 31 of housing 32, while bias voltage for the cathode of assembly 16 and energization current for the cathode heater are applied to two "live" terminal connector 38 on housing wall 31. Tuning for the vacuum tube of FIG. 1, over a relatively narrow frequency range, is provided by moving metal plate 40 transversely of center line 28 in coupler 14.

The grid of assembly 16 is fabricated of non-electron emissive material, such as pyrolytic graphite or molybdenum coated with zirconium, and spaced from the assembly cathode by a distance no greater than the distance an electron emitted from the cathode can reach the grid in a quarter cycle of the signal applied to connector 10.

This type of construction is described in the aforementioned patents. The grid and cathode of assembly 16 respond to the signal coupled to them via coaxial connector 10 to current modulate the linear electron beam emitted by the cathode and accelerated by anode 18 to collector 22. The resulting electron bunches propagating from the grid of assembly 16 and through opening 19 in anode 18 interact with resonant modes of the structures surrounding the region between the grid and anode 18 to cause r.f. fields at many frequencies to be established in the interaction region. See Column 5, line 14-65

Therefore it would have been obvious to one of ordinary skill in the art that the linear accelerator drift tube of Cutler (463) can be modified to use the electron beam source in accordance with Shrader (625), to provide an electron beam RF field source coupled to the drift tube, thereby accelerating the ion beam.

Regarding Claims 10-18, and 22-36, Shrader (625) also discloses that the coupling means includes an input cavity resonant to the frequency of the signal for achieving the correct phase relation between the grid and cathode.

In one preferred embodiment, the coupler includes a loop in a space between inner and outer coaxial metal signal coupling tubes having a length of about $n\lambda/4$ between the grid and loop, where λ is the wavelength of a frequency in the band, and n is an odd integer. The inner and outer tubes are respectively electrically connected to the cathode and grid. The grid and outer coaxial tube are DC isolated from the cathode and inner coaxial tube, enabling a DC bias voltage to be applied between grid and cathode and the cathode to be at a high negative DC voltage (e.g., -85 kV or -32

kV) relative to the preferably grounded anode. Preferably a DC bias connection is provided for the grid on the outer tube at a position $n_1\lambda/4$ from the grid, where n_1 is an odd integer less than n; this position minimizes the r.f. voltage coupled to a source of the DC bias.

In other embodiments, the coupler includes a grounded coaxial cable having inner and outer conductors connected to the signal source. The inner conductor is connected to first metal face spaced from a second opposed metal face by a solid dielectric. The outer conductor is connected to a third metal face spaced from a fourth opposed metal face by the solid dielectric. The third and fourth faces respectively surround the first and second faces. The dielectric extends beyond the periphery of the metal faces so a substantial DC voltage can be established between the faces; the first and third faces are at DC ground potential while the second and fourth faces are at high negative DC voltages. The second and fourth faces are respectively at common ends of interior and exterior coaxial metal tubes forming a half-wavelength coaxial coupler. The other ends of the interior and exterior tubes are respectively connected to the cathode and grid.

Also one way of varying the coupler resonant frequency is to form the coupler as a pair of variable length concentric meal tubes that are electrically insulated from each other; fine tuning is provided by a capacitor plate transversely movable between the tubes.

In another arrangement, a secondary cavity is electromagnetically coupled to the coupler. A shorting plunger in the secondary cavity is translated to effectively change the electrical length of the secondary cavity and the coupler resonant frequency.

In yet a further arrangement, the tubes are fixed in position and have a fixed length. Metal fingers, functioning as inductive elements extending between the inner and outer tubes, are positioned at different places along the lengths of the tubes to change the coupler resonant frequency.

In the most preferred arrangement, the tubes are also fixed in position and have a fixed length. To change the coupler resonant frequency, a shorting plunger in the secondary cavity is adjusted to effectively change the electrical length of the secondary cavity and inductive elements, extending between the inner and outer tubes, are positioned at different places along the lengths of the tubes. See Column 3, line 25-67, and Column 4, line 1-17.

Conclusion

3. Any inquiry concerning this communication or earlier communications should be directed to Phillip Johnston whose telephone number is (703) 305-7022. The examiner can normally be reached on Monday-Friday from 7:30 am to 4:00 pm. If attempts to

reach the examiner by telephone are unsuccessful, the examiners supervisor John Lee can be reached at (703) 308-4116. The fax phone numbers are (703) 872-9318 for regular response activity, and (703) 872-9319 for after-final responses. In addition the customer service fax number is (703) 872- 9317.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 0956.

PJ

August 14, 2003

Bruce Anderson

BRUCE ANDERSON
PRIMARY EXAMINER